Brute-force, Dictionary Attacks and Mitigation

João Bettencourt

Fakulteta za elektrotehniko, računalništvo in informatiko, Univerza v Mariboru
Email: joao.bettencourt@um.si

The increasinng volume on digital systems in the modern society has increased the importance of security measures. One of the most persistent threats to digital security is the brute-force and dictionary attack, which exploits weak passwords to be harmful to systems. This paper explores these attack techniques, their mechanisms, and their impact on the modern society. By understanding the key points behind brute-force and dictionary attacks, we can identify vulnerabilities in password systems and propose effective mitigation strategies. This topic was chosen due to its significant relevance in today's digital age, where establishing security standards and practices is essential for protecting sensitive information. The study also emphasizes the need for stronger authentication methods and awareness to protect against evolving attack techniques. By combining theoretical analysis with practical demonstrations using tools such as Kali Linux, this work aims to highlight not only the risks posed by these attacks but also measures to improve digital security.

Keywords: Brute-Force Attacks, Dictionary Attacks, Password Security, Cybersecurity.

1. INTRODUCTION

Password-based authentication remains one of the most common methods for system security, based on their simplicity and effiency. However, it continues to show significant vulnerabilities, facing brute-force and dictionary attacks. Those methods exploit the inherent weaknesses of user-created passwords, which are often short, predictable and based on common patterns. In spite of decades of research and development of numerous countermeasures, the human factor remains the weakest link in the security trifecta.

By the new advancements in computational power, these vulnerabilities got aggravated, making attackers more effient cracking passwords. A task that used to require days now takes seconds or even less. At the same time, passwords cracking techniques have become progressively sophisticated, including vast dictionaries, permutations, and adaptive algorithms. These developments highlight the critical need for powerfull mitigation strategies that not only address technical vulnerabilities but also focus on improving user practices

This study investigates the mechanics of brute-force and dictionary attacks, demonstrates their effectiveness using practical experiments, and evaluates their strengths and weaknesses of most commonly used mitigation strategies. By analyzing passwords, by their entropy and characteristics, this work aims to emphasize the importance of adopting strategies to mitigate these attacks, by adopting stronger password policies and multi-factor authentication methods.

2. LANGUAGE, SIZE, AND FORMAT

The article must be written in the English language and must be linguistically sound. Its length should be between 5 and 10 pages. Shorter or longer papers will be penalized based on the number of pages under/over the limit.

The lines should be spaced exactly one space apart. There should be a 6 pt space before each paragraph. Do not leave extra blank lines between paragraphs. The spacing between paragraphs should be 18 pt before and 6 pt after chapters, and 12 pt before and 6 pt after subchapters. Start writing paragraphs on the left and do not make indentations to the right. The text should be aligned in a block (center alignment, i.e. left and right margin aligned). Letter size should be 12, Times New Roman font. The entire text should be aligned in two columns. You can follow the given template to achieve this.

2.1. Figures, lists, and tables

Within the text, you must refer at least once to the displayed figures, tables and/or equations. Example: The figure **??** shows a theoretical research model. The **??** image shows the registration button.

Use the *itemize* command to create a list as follows:

- The first enumeration element,
- Second enumeration element and

TABELA 1: Title of the small table

Variable	Coefficient	P
Gender	4.31	0.001
Age	2.33	0.005
GCS1	8.24	0.001
GCS2	9.12	0.001

- The third enumeration element.

Numbering is also used in the same way as enumeration, using the *enumerate* command. You can see an example below:

1. The first numbering element,
2. Second numbering element and
3. The third numbering element.

Tables must have a description that unambiguously describes the data presented in the table. It is also necessary to refer to all the tables in the article.

This document is written in the format that the article should be in, and is useful as a template for writing with LaTeXin the Overleaf environment.

Praesent pellentesque, elit id varius sagittis, urna leo viverra magna, ac consectetur sapien justo eu sapien. As has been shown (Laramee 2009) Cras viverra nulla in arcu posuere id sollicitudin leo sollicitudin. Suspendisse gravida odio vel arcu ltrices ultrices. Integer elementum elit rhoncus lectus gravida imperdiet. Nulla et lorem lacus, in commodo arcu. Vivamus a nisl elit. Curabitur nisl nisi, laoreet in tristique ac, facilisis eu justo. Proin consequat metus id libero consectetur ultricies. Phasellus commodo adipiscing posuere [**?**].

Nam augue erat, posuere eu condimentum ut, lacinia eget eros. Nam sit amet nibh magna, hendrerit ultrices urna. Morbi id augue dui. Donec eros ligula, mattis eu rhoncus id, molestie ut nulla. Eenean vulputate, mi eu ultrices ullamcorper, neque ligula varius diam, a luctus ante quam vitae felis. Praesent dignissim aliquet augue nec interdum. Pellentesque nec fermentum neque. Donec libero sem, sagittis ac pretium quis [**?**].

Praesent pellentesque, elit id varius sagittis, urna leo viverra magna, ac consectetur sapien justo eu sapien. As has been shown (Laramee 2009) Cras viverra nulla in arcu posuere id sollicitudin leo sollicitudin. Suspendisse gravida odio vel arcu ltrices ultrices. Integer elementum elit rhoncus lectus gravida imperdiet. Nulla et lorem lacus, in commodo arcu. Vivamus a nisl elit. Curabitur nisl nisi, laoreet in tristique ac, facilisis eu justo. Proin consequat metus id libero consectetur ultricies. Phasellus commodo adipiscing posuere.

3. IMPORTANT INSTRUCTIONS

In the list of resources at the end of the article, list all the resources that you used to create the article (scientific and professional articles, conference proceedings, books, websites, etc.) that you refer to as part of the assignment. Detailed instructions for citing sources are provided in the next subsection.

3.1. Citing

You should use references to refer to the resources in the article. By referring, you indicate that a particular thought, a particular procedure, or a particular claim is not yours, but you have read it somewhere and are quoting it. If you are literally copying the source, you need to put it in quotation marks and state the source at the end. However, if you are summarizing the source, it is not necessary to use quotation marks, but you must refer to the source at the end of the sentence.

It makes sense to edit the resources in an external file (.bib), using the Bibtex reference format. Referencing the sources is mandatory! To reference a source, use the *cite* command to specify a key that uniquely identifies the source in the source list. The sources are also collected and listed in a list at the end of the document. Each listed item should include all relevant information about the mentioned source. The References section provides examples of references to a book, article, and online resource; for other types of resources you can refer to the LaTeXdocumentation.

Nam augue erat, posuere eu condimentum ut, lacinia eget eros. Nam sit amet nibh magna, hendrerit ultrices urna. Morbi id augue dui. Donec eros ligula, mattis eu rhoncus id, molestie ut nulla. Aenean vulputate, mi eu ultrices ullamcorper, neque ligula varius diam, a luctus ante quam vitae felis. Praesent dignissim aliquet augue nec interdum. Pellentesque nec fermentum neque. Donec libero sem, sagittis ac pretium quis, ultrices nec massa. Donec sed felis felis. Vestibulum sed turpis felis. Figure **??** showcases a registration button.

4. CHAPTER

Nam augue erat, posuere eu condimentum ut, lacinia eget eros. Nam sit amet nibh magna, hendrerit ultrices urna. Morbi id augue dui. Donec eros ligula, mattis eu rhoncus id, molestie ut nulla. Aenean vulputate, mi eu ultrices ullamcorper, neque ligula varius diam, a luctus ante quam vitae felis. Praesent dignissim aliquet augue nec interdum. Pellentesque nec fermentum neque. Donec libero sem, sagittis ac pretium quis, ultrices nec massa. Donec sed felis felis. Vestibulum sed turpis felis [**?**].

Explanation: Coefficients are beta coefficients of logistic regression. GCS1 and GCS2 are determined on clinical examination before surgery. Nam augue erat, posuere eu condimentum ut, lacinia eget eros. Nam sit amet nibh magna, hendrerit ultrices urna. Morbi id augue dui. Donec eros ligula, mattis eu rhoncus id, molestie ut nulla. Aenean vulputate, mi eu ultrices ullamcorper, neque ligula varius diam, a luctus ante quam vitae felis. Praesent dignissim aliquet augue nec interdum. Pellentesque nec fermentum neque. Donec

TABELA 2: Title of a large table

Authors	Constructs	Context IT	Method	Conclusions
Davis	PU, PEOU, U	PROFs, XEDIT, Chart-Master, Pendraw	Survey, experiment	PEOUàU
Davis, Bagozzi in Warshaw	PU, PEOU, A, BI, U	WriteOne	Experiment	PEOUàPU, PUàA, PEOUàA, AàBI, PUàBI, BIàU
Haynes in Thies	PU, PEOU, U	Automatic pager	Survey	PUàU, PEOUàU
Mathieson	EV, PU, PEOU, A, BI, U	Table, calculator	Experiment	PUàU, PEOUàU

libero sem, sagittis ac pretium quis, ultrices nec massa. Donec sed felis felis. Vestibulum sed turpis felis [**?**]. Explanation: Coefficients are beta coefficients of logistic regression. GCS1 and GCS2 are determined on clinical examination before surgery [1].

5. CONCLUSION

The article ends with a conclusion in which you once again state the issues you have described, the main features and your observations or results. In the end, you describe what you presented in the whole document and what you "achieved"with the presentation, so you describe the results of your work and the new insights you have gained through research in the field. You can also indicate opportunities for further research and work.

Nam augue erat, posuere eu condimentum ut, lacinia eget eros. Nam sit amet nibh magna, hendrerit ultrices urna. Morbi id augue dui. Donec eros ligula, mattis eu rhoncus id, molestie ut nulla. Aenean vulputate, mi eu ultrices ullamcorper, neque ligula varius diam, a luctus ante quam vitae felis. Praesent dignissim aliquet augue nec interdum. Pellentesque nec fermentum neque. Donec libero sem, sagittis ac pretium quis, ultrices nec massa. Donec sed felis felis. Vestibulum sed turpis felis.

- Pellentesque nec fermentum neque.
- Nam sit amet nibh magna, hendrerit
- Aenean vulputate, mi eu ultrices

Eenean vulputate, mi eu ultrices ullamcorper, neque ligula varius diam, a luctus ante quam vitae felis. Praesent dignissim aliquet augue nec interdum. Pellentesque nec fermentum neque. Donec libero sem, sagittis ac pretium quis, ultrices nec massa. Donec sed felis felis. Vestibulum sed turpis felis

[1] Footnote